

## ABSTRACT

A silicon single crystal rod (24) is pulled from a silicon melt (13) molten by a heater (17), and a change in diameter of the silicon single crystal rod every predetermined time is fed back to a pulling speed of the silicon single crystal rod and a temperature of the heater, thereby controlling a diameter of the silicon single crystal rod. A PID control in which a PID constant is changed on a plurality of stages is applied to a method which controls the pulling speed of the silicon single crystal rod so that the silicon single crystal rod has a target diameter and a method which controls a heater temperature so that the silicon single crystal rod has the target temperature.

A set pulling speed for the silicon single crystal rod is set so that  $V/G$  becomes constant, and an actual pulling speed is accurately controlled so as to match with the set pulling speed, thereby suppressing a fluctuation in diameter of the single crystal rod.

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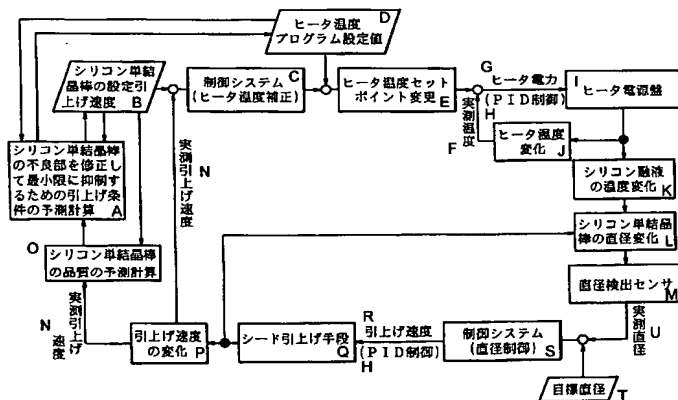
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**(54) Title: METHOD OF PRODUCING SILICON MONOCRYSTAL**

(54) 発明の名称: シリコン単結晶を製造する方法



**(57). Abstract:** A silicon monocrystal rod (24) is pulled out from melted silicon liquid (13) melted by a heater (17), and variation in the diameter of the rod at predetermined time intervals is fed back to a pull-up speed of the rod and to a heater temperature to control the diameter of the rod. PID control is applied to a method for controlling a pull-out speed of a silicon monocrystal rod so that the rod has an aimed diameter, and to a method for controlling a heater temperature so that the rod has an aimed diameter, and a PID constant is varied in plural steps in each of the methods. When a preset pull-out speed of a silicon monocrystal rod is set so that  $V/G$  is constant, and an actual pull-out speed is controlled with high accuracy so that the actual pull-out speed corresponds to the preset pull-out speed, the diameter of the silicon monocrystal rod is prevented from varying.

- A...ESTIMATION CALCULATION OF PULL-OUT CONDITIONS TO MINIMIZE DEFECT OF SILICON MONOCRYSTAL ROD BY MODIFYING IT
- B...PRESET PULL-OUT SPEED OF SILICON MONOCRYSTAL ROD
- C...CONTROL SYSTEM (HEATER TEMPERATURE COMPENSATION)
- D...HEATER TEMPERATURE PROGRAM PRESET VALUE
- E...CHANGE OF HEATER TEMPERATURE SET POINT
- F...MEASURED TEMPERATURE
- G...HEATER ELECTRIC POWER
- H...(PID CONTROL)
- I...HEATER POWER SOURCE BOARD
- J...HEATER TEMPERATURE VARIATION
- K...VARIATION IN MELTED SILICON LIQUID TEMPERATURE
- L...VARIATION IN SILICON MONOCRYSTAL ROD DIAMETER
- M...DIAMETER DETECTION SENSOR
- N...MEASURED PULL-OUT SPEED
- O...ESTIMATION CALCULATION OF QUALITY OF SILICON MONOCRYSTAL ROD
- P...VARIATION IN PULL-OUT SPEED
- Q...SEED PULL-OUT MEANS
- R...PULL-OUT SPEED
- S...CONTROL SYSTEM (DIAMETER CONTROL)
- T...AIMED DIAMETER
- U...MEASURED DIAMETER

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